# How [Not] To Run a [Cybersecurity] Capstone

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Presented to *NICE Conference and Expo*
November 2019

# Disclaimers

- **Opinions expressed are those of the presenter.**
- **Any books, products or websites referenced in this briefing are for illustrative purposes only, and should not be interpreted as official endorsements by the presenter, Norfolk State University or its research partners.**

- **Dr. Mary Ann Hoppa**
  - **CS and CYS faculty at NSU**
  - **Co-PI, NSU Cybersecurity Center of Excellence & PDC/APT grant**
  - **Cybersecurity Graduate Program Coordinator**
  - **30+ years IT R&D experience**
  - **Research interests:**
    - **Cybersecurity**
    - **Cyberpsychology**
    - **Big Data; visualization**
    - **Serious Games**
    - **Information/Knowledge Management**
    - **ICS/SCADA Security**
    - **Blockchain Technology**


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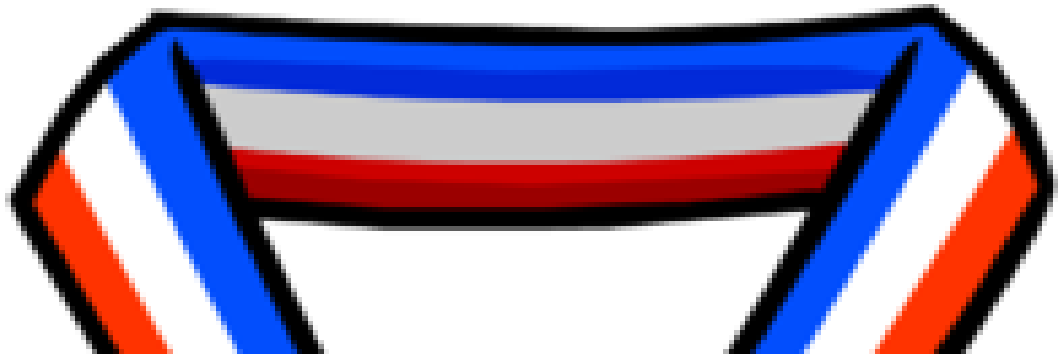
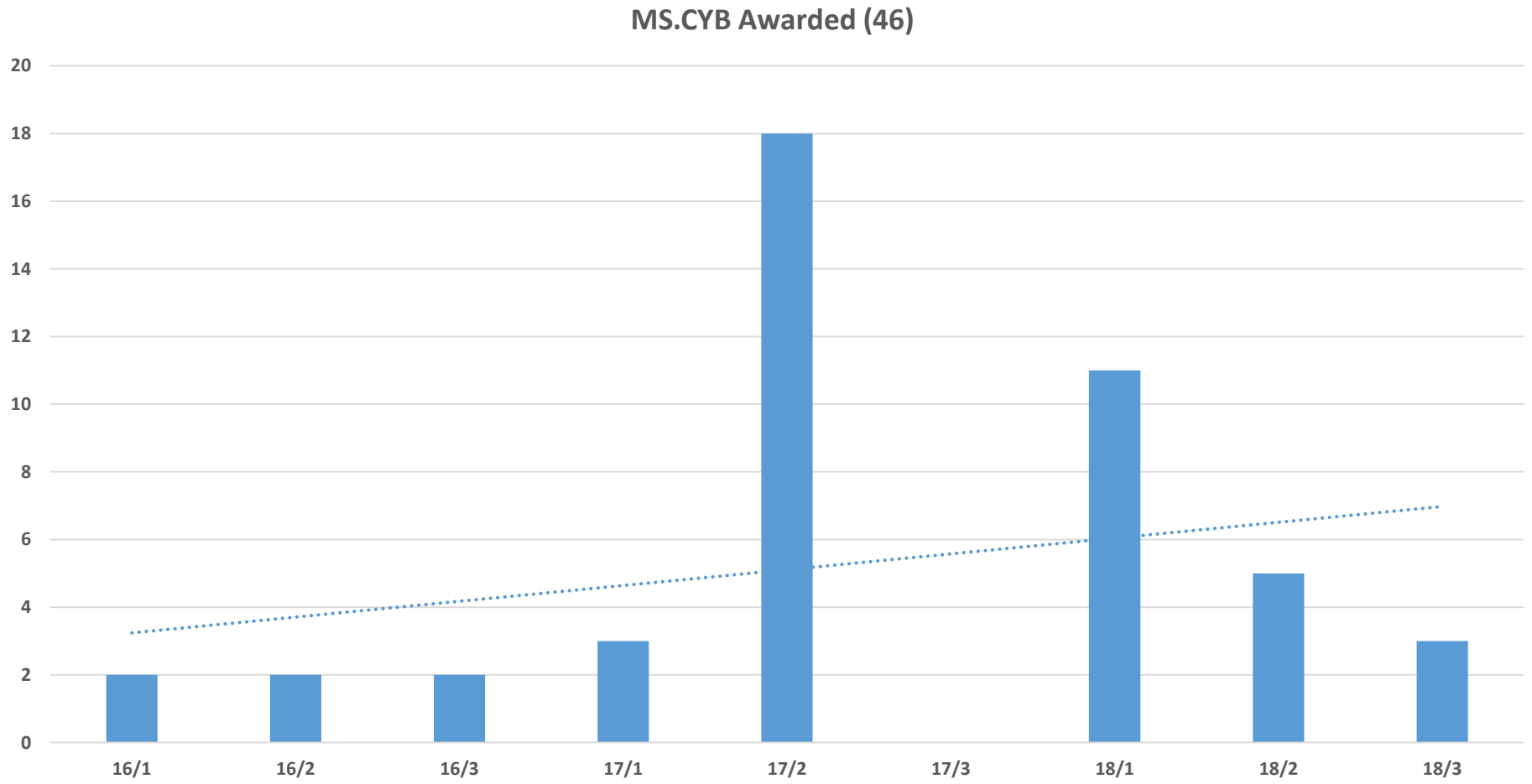


NSU placed in the “50 Best Schools of 2018: Online Master’s Degrees in Cybersecurity,” distinguishing it among hundreds across the nation.

# Stats

| | |
|---|---|
| **19/1** | **60** active students **9** “IP” Capstones **12** “I” Capstones |
| **AVG GPA** | 3.74 |



# Supporting environment

- **15 full-time teaching faculty [for the whole department]**
- **Undergraduate Cybersecurity**
  - **BS.CS.DCYB (Honors)**
  - **BS.CS.IA**
  - **~350 total CS enrollees, ~50 graduates annually**
- **Graduate Cybersecurity**
  - **~ 65 in-progress, ~20 degrees awarded annually**
  - **mostly non-traditional students**
  - **2 - 3 years from acceptance to degree**
    - **20% “incomplete” rate on capstone**
  - **Strong internship relationships**
  - **Prestigious intern/employment placements including:**
    - **Perdue, Sandia, NSA, SPAWAR, AFRL, BAH**
- **Additional relationships**
  - **MS.CSC, ABET, NSA/DHS CAE, NNSA K-20 Consortium, …**

# State-of-the-Art Facilities


- **Cybersecurity Complex**
  - **Datacenter: ~830 Terabytes memory, ~1700 cores**
  - **Cybersecurity Research Lab, Cyberpsychology Lab**
  - **Digital Forensics Lab**
  - **NDG NETLAB+ System**

NEW

- **DoD Research & Education Program Grant (PDC teaching & APT research)**

- **Cybersecurity/Cloud Research Lab (ODU)**
- **Human Dynamics, Cybersecurity/Military Laboratories (ODU)**

- **NSU-ODU direct fiber optic link**

# NSU Cybersecurity MS Program

- **CSC 535 Computer Security I**
- **CSC 555 Management of Information Security**
- **CYS 564 Secure Operating Systems**
- **CYS 573 Network Fundamentals**
- **CYS 672 Computer and Network Forensics**
- **CYS 688 Human Aspects of Computing**
- **CYS 697 Ethical Hacking and Penetration Testing**
- **CYS 721 Database Security**
- **CYS 755 Healthcare Information Security**
- **CYS 765 Advanced Topics in Cybersecurity**
- **CYS 795 Cybersecurity Capstone**

- 30 credit-hours

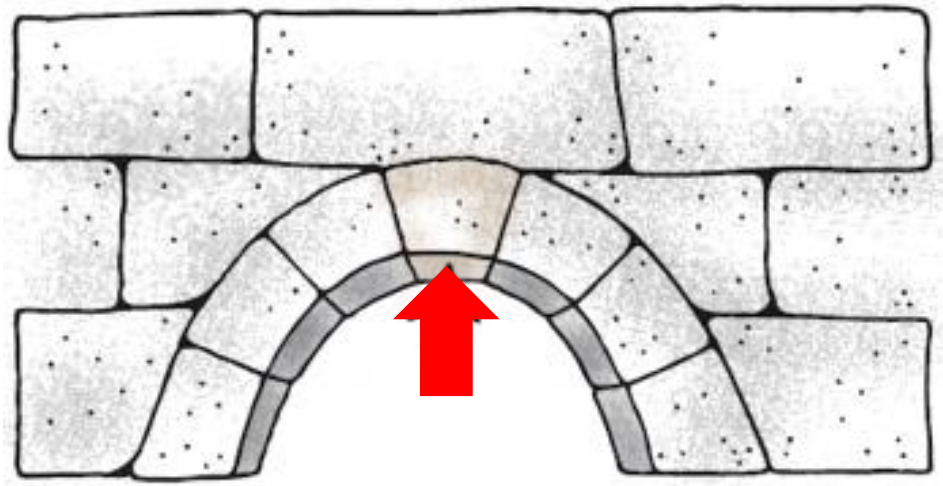
  PLUS
- 6 credit-hour Capstone
- 100% online

# What is a Capstone?

- **Integrates** the most important knowledge acquired from an entire learning trajectory (e.g., degree program)

- **Shows** what a student has mastered by proposing and solving a distinctive problem.

- **Documents** findings in a formal report*
  - often presented in traditional “defense” setting.



* publication-quality highly desirable

# There are options!

- **Replicate** previously published experiment to validate or refute findings
- **Conduct** an original experiment to investigate an open research question
- **Compare** commercial cybersecurity products or competing strategies; e.g., develop appropriate selection criteria;
- **Propose** best-practice recommendations for improved cybersecurity outcomes against particular attacks or within a particular domain.

**NOTE**: Instead of capstone, some programs include options for candidates to complete additional coursework OR participate in a group penetration or defense exercise.

**What kind of graduates are you trying to build??**

# Common capstone missteps

- **Insufficient timeline**
- **Informality / lack of rigor / lack of depth**
- **Lack of focus / systematic approach**
- **Lack of analysis / synthesis / conclusions / recommendations**
- **Group projects without individual accountability**
- **Dueling outcomes**
  - **grooming academics OR preparing graduates to compete in the workforce?**
- **Underestimating resources needed to establish, grow & evolve the program**

# “Shoehorn” the curriculum

- **Fit the capstone into the available “slot” … whether or not the timeline makes sense**

# Don’t discourage any potential applicant!

- **Cast the widest possible recruitment net to get the numbers up, regardless of “cyber-readiness”!**
- **Don’t worry about cohorts, course order or similar experiences going into the capstone.**


**Let the unprepared sink or swim … who needs formal advisement or a bridge program??**

# Data-driven decision-making not needed here!

- **No need for statistics, such as:**
  - **Average time-to-graduation**
  - **Student internships / placements**
  - **Per-course enrollment predictions**
- **Cohorts…SMO-horts!**
  - **Let faculty preferences drive courses & capstone topics versus a regular schedule of offerings or student needs**
  - **Online students want to work alone … no need for community-building!**

# Don’t be prescriptive either!

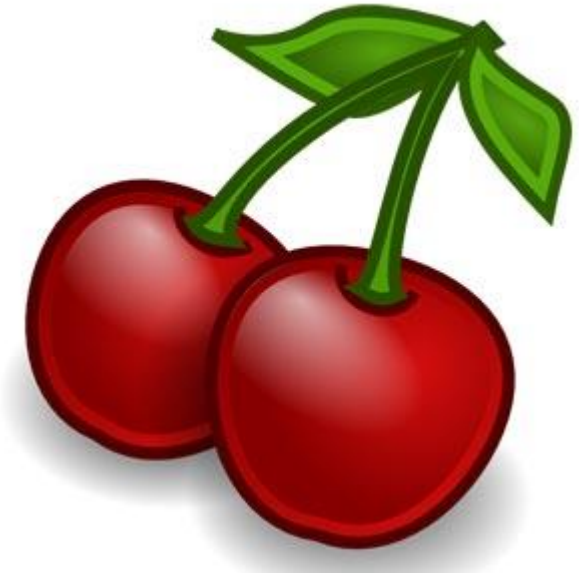

Who needs…?

- Program / capstone handbook
- Proposal / final report templates
- Advisor / advisee agreements
- Clear “drop-dead” dates
- Exception procedures

**Why bother with “living” electronic content … wait a few years to figure it out … haven’t paper handouts always worked??**

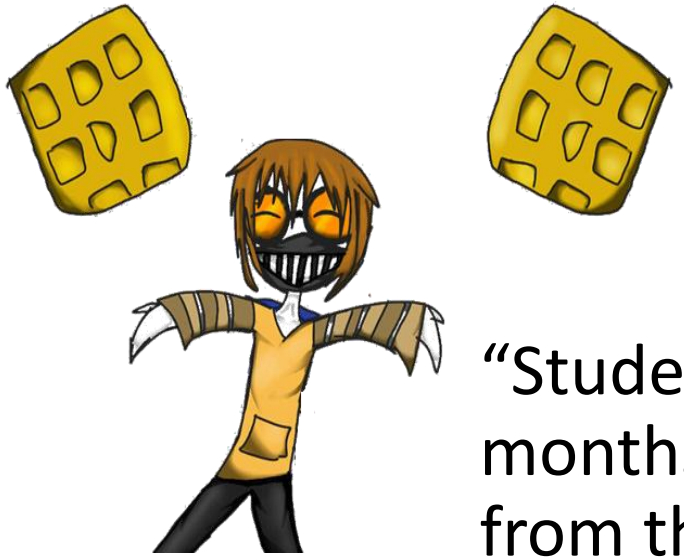
# Encourage faculty to cherry pick [or avoid] advisees…

- Don’t advisors and advisees just pair up naturally…so what if students aren’t on campus?
- Don’t factor capstone advisement into faculty workloads either!



**No need to worry about “virtual” ways to forge relationships!**

# Waffle on “requirements”



“Students typically take this course after completing eight (8) cybersecurity courses with a 3.0 or better GPA, *or with the permission of the instructor.”*

“Students must submit a research proposal, preferably two months prior to enrolling in the course, to obtain approval from the Cybersecurity Program Director.”

“Although publication is not a requirement to receive the degree, the student must produce a publication-quality report.”

**Make sure everything’s negotiable!**
**Since every capstone is unique, standard formats & expectations are unnecessary.**


REALITY
CHECK

# Better practices

*Capstone*

Good, Better, Best

- **Spread the experience across two semesters**
  - **Capstone 1: plan, advisor, reviewer; Capstone 2: execute**
  - **Establish intentional student/faculty engagements on research topics**
    - **NOTE: "virtual" require different approaches**
- **Have a capstone "handbook" and FAQs for both students & faculty**
  - **Clarify & ensure consistent expectations**
- **Hold everyone to standards of performance, documentation**
  - **Advisor-advisee agreements**
  - **Templates & timelines at a minimum**
  - **Well-formed, reusable course syllabi**
- **When resources are limited…**
  - **"Cohort up" the students**
  - **Collect/maintain data to rationalize needs**

# Better practices

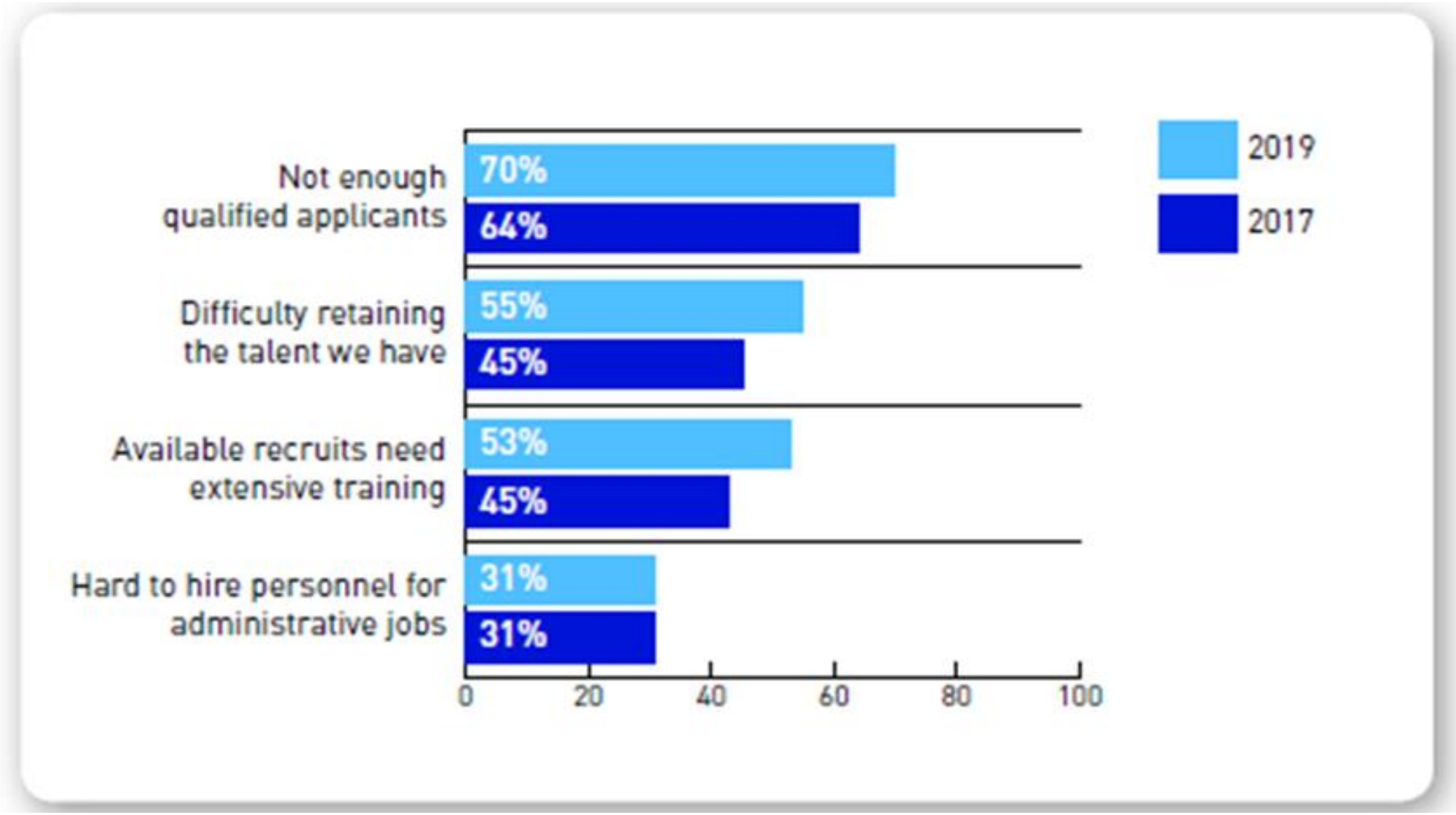
*Program*

Good, Better, Best

- **Provide intentional relationship-building experiences: faculty-to-student, student-to-student**
  - **Speaker series; speed networking;**
  - **Leverage [nascent] grad school professional development initiative**
- **Consider offering a non-capstone option**
  - **Offer electives to help program flex and grow**
- **Capture statistics to show administrators, boards, grants, potential students, other stakeholders**
- **Require students with non-IT/CS backgrounds to demonstrate basic competencies or take a bridge program**
  - **Identify “bridge” CS courses for non-CS majors who want to “cross over” at the MS level**


Q&A

# Increasing skill gaps in multiple dimensions**




** Tripwire 2019 Skills Gap Survey, March 2019